

# A Multiwire-Proportional-Chamber System Used to Monitor Off-Momentum Beam in Accelerators

C. Pillai, R.B. Merl, C.A. Burns, A.I. Steck (LANSCE Division)

Identifying and eliminating unwanted off-momentum components in an accelerator beam is critical for maintaining the transverse and longitudinal parameters of the beam to within the specifications of the accelerator. The off-momentum components in an accelerator beam appear when the beam goes through a dispersive element such as a bending magnet. At the exit of this bending magnet, the different energy (i.e., momentum) beam components are separated [e.g., analogous to the way the various color (wavelength) components of a beam of light are separated when crossing a prism]. This type of bending magnet is located at the end of the Los Alamos Neutron Science Center's (LANSCE) proton linear accelerator (linac). Normally, a phosphor screen illuminated by the low-energy beam at the exit of the magnet is monitored by a camera.

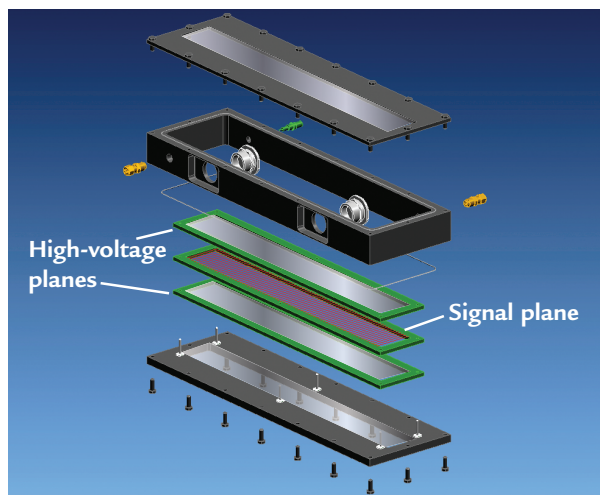
This phosphor screen has been superseded by a proportional chamber that detects and eliminates the low-momentum components of the linac beam.

## Multiwire Proportional Chamber Replaces Phosphor Screen

We have developed a multiwire proportional chamber (MWPC) to replace the phosphor-camera system. This MWPC is positioned to detect protons with an energy smaller than that of the full 800-MeV beam, which is deflected outside the chamber. This new chamber gives a much better position resolution ( $\sim 2$  mm) than that of the phosphor-camera system ( $\sim 1$  cm). The phosphor does not respond well when the intensity of a low-momentum beam is less than a few nA, whereas the MWPC is sensitive even at a few pA. The MWPC is thus more efficient at detecting weak off-energy components of the beam than a phosphor detector. Moreover, the gain (multiplication factor) of the MWPC can very easily be changed by adjusting its high voltage, making it possible to change the sensitivity of the device to off-energy components.

The chamber includes three frames made of G-10 fiberglass with an active area of  $300 \text{ cm}^2$  ( $50 \text{ cm} \times 6 \text{ cm}$ ). There is 1 frame, called a signal frame, with 64 gold-plated tungsten wires ( $20 \text{ }\mu\text{m}$  in diameter) that have a 2-mm spacing between adjacent wires (Fig. 1). Only wires close to the beam particle trajectory are activated. There are two other frames, each covered with an aluminum foil, on either side of the signal frame to handle the high voltage. The whole assembly is enclosed in an aluminum box with  $6\text{-}\mu\text{m}$  aluminum windows covering the active area of the detector and flushed with a gas mixture of argon and methane (90% and 10% in volume, respectively).

The signal from each wire is digitized by a custom-made digitizer and can be displayed on any computer terminal. This signal indicates the presence of a particular low-energy beam component, which has to be eliminated or minimized to achieve optimum tuning



**Fig. 1.** Schematic of the MWPC.

of the accelerator. The signals from the wires are also fast enough to identify beam losses arising from low-energy components across the entire macropulse of the beam. If necessary, high-energy components of the linac beam could also be detected by locating the MWPC on the other side of the main beam.

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*For more information, contact Chandra Pillai (LANSCE Division), (505) 667-8797, MS H812, [pillai@lanl.gov](mailto:pillai@lanl.gov).*

***Produced by the LANSCE-4 communications team:  
Sue Harper, Grace Hollen, Annie Loweree, Barbara Maes,  
and Sharon Mikkelsen.***



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